MULTIMEDIA UNIVERSITY

STUDENT ID NO

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# MULTIMEDIA UNIVERSITY

# FINAL EXAMINATION

**TRIMESTER 3, 2016/2017**

## DCA5068 – FIELD THEORY

(ALL GROUPS)

30 MAY 2017
2.30 p.m –4.30 p.m
(2 Hours)

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**INSTRUCTIONS TO STUDENT**

1. This question paper consists of **4** pages (**3** pages for questions and **1** page for appendix).
2. Answer **ALL** questions.
3. Please write all your answers in the answer booklet provided.

**QUESTION 1 [25 MARKS]**

a) In Cartesian coordinates, vector $\vec{A}$ is directed from the origin to point Q1 = (2, 3, 9), and vector $\vec{B}$ is <-2, -1, 4>. Find:

i) Vector $\overrightarrow{AB}$.

[3 marks]

ii) Unit vector, $\hat{a}$.

[4 marks]

iii) Length of projection of $\vec{B}$ on $\vec{A}$.

[3 marks]

iv) $\vec{A} \times \vec{B}$.

[3 marks]

b) Given P is (3,2,-7) and Q (-1,-4,2) in Cartesian coordinate system. Transform the vector $\overrightarrow{PQ}$ at point P into cylindrical coordinate systems.

[8 marks]

c) Draw a suitable diagram that can explain the First Law of Electrostatic.

[2 marks]

d) Complete Figure 1 by drawing the magnetic lines of force.

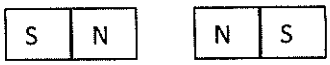


Figure 1 [2 marks]

**Continued...**

## QUESTION 2 [25 MARKS]

a) A charge, $q_1 = 20\mu C$ is located at A(1,2,3), and a charge $q_2 = -10\mu C$ is at B(2,0,5) Determine the vector force on $q_1$ and its magnitude. All measurements of length are in meters.

[9 marks]

b) What will happen to the molecules of dielectric material when it is placed in the electric field?

[2 marks]

c) Two straight wires in Figure 2 each carry a current of $I = 5\,A$ in same direction with the distance between them is $d = 30\,cm$. Find the total magnetic field at distance $l = 20\,cm$ to the right of the wire on the right.

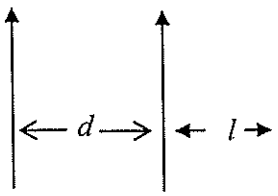


Figure 2

[5 marks]

d) Draw the induced current according to the direction of original current, $I$ and magnetic field, $B$ shown in Figure 3 when the magnetic field is increased.

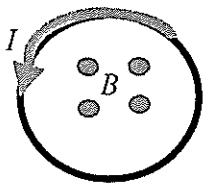


Figure 3

[2 marks]

e) A solenoid 52 cm long and 2 cm in diameter can produce a magnetic field of 3.25 T at its center.

i) Calculate the current of the solenoid when if it has 5000 turns of wire.

[3 marks]

ii) What happens to the magnetic field if the diameter of the solenoid increase to 5 cm?

[1 mark]

f) Describe **three** ways to induced electromagnetic force (EMF).

[3 marks]

**Continued...**

## QUESTION 3 [25 MARKS]

a) Calculate the current needed to be supplied to a 500 turns solenoid to get the magnetomotive force equal of 200 At.

[3 marks]

b) What is the magnetic field intensity if a solenoid having $MMF$= 50 At and the mean path length of the magnetic flux is 20 m. Given $H = (F/l)$.

[2 marks]

c) Define permeability.

[ 2 marks]

d) There are three variations in Hysteresis Curves. Draw **all** of the curves and describe each of it.

[12 marks]

e) State **three** similarities between Electric Force and Magnetic Force.

[6 marks]

## QUESTION 4 [25 MARKS]

a) There are three general types of transformer core.

i) State the **three** types of transformer core and draw the schematic symbol for each.

[6 marks]

ii) Describe the general application of ferrite core and iron core transformer.

[2 marks]

b) Explain the advantages of core type and shell type transformer.

[4 marks]

c) What will be happened to the direction of voltage induced in primary and secondary coil of the transformer when the winding in both coil is opposite to each other?

[2 marks]

d) Explain the purpose of step-up transformers.

[2 marks]

e) A transformer has 212 turns in the primary, 100 turns in the secondary, and 240 volts applied to the primary ($V_p$). Calculate the voltage across the secondary ($V_s$).

[3 marks]

f) If the input power to a transformer is 720 watts and the output power is 698 watts, what is the efficiency?

[3 marks]

g) A transformer with a turns ratio of 20 is having load resistance of 20Ω.Calculate the reflected resistance in the primary.

[3 marks]

**End of Page.**

# FORMULAE

| Transformation | Coordinate Variables | Unit Vectors | Vector Components |
|---|---|---|---|
| Cartesian to Cylindrical | $r=\sqrt{x^2+y^2}$<br>$\phi=\tan^{-1}(y/x)$<br>$z=z$ | $\hat{r}=\hat{x}\cos\phi+\hat{y}\sin\phi$<br>$\hat{\phi}=-\hat{x}\sin\phi+\hat{y}\cos\phi$<br>$\hat{z}=\hat{z}$ | $A_r=A_x\cos\phi+A_y\sin\phi$<br>$A_\phi=-A_x\sin\phi+A_y\cos\phi$<br>$A_z=A_z$ |
| Cylindrical to Cartesian | $x=r\cos\phi$<br>$y=r\sin\phi$<br>$z=z$ | $\hat{x}=\hat{r}\cos\phi-\hat{\phi}\sin\phi$<br>$\hat{y}=\hat{r}\sin\phi+\hat{\phi}\cos\phi$<br>$\hat{z}=\hat{z}$ | $A_x=A_r\cos\phi-A_\phi\sin\phi$<br>$A_y=A_r\sin\phi+A_\phi\cos\phi$<br>$A_z=A_z$ |
| Cartesian to Spherical | $R=\sqrt{x^2+y^2+z^2}$<br>$\theta=\tan^{-1}(\sqrt{x^2+y^2}/z)$<br>$\phi=\tan^{-1}(y/x)$ | $\hat{R}=\hat{x}\sin\theta\cos\phi+\hat{y}\sin\theta\sin\phi+\hat{z}\cos\theta$<br>$\hat{\theta}=\hat{x}\cos\theta\cos\phi+\hat{y}\cos\theta\sin\phi-\hat{z}\sin\theta$<br>$\hat{\phi}=-\hat{x}\sin\phi+\hat{y}\cos\phi$ | $A_R=A_x\sin\theta\cos\phi+A_y\sin\theta\sin\phi+A_z\cos\theta$<br>$A_\theta=A_x\cos\theta\cos\phi+A_y\cos\theta\sin\phi-A_z\sin\theta$<br>$A_\phi=-A_x\sin\phi+A_y\cos\phi$ |
| Spherical to Cartesian | $x=R\sin\theta\cos\phi$<br>$y=R\sin\theta\sin\phi$<br>$z=R\cos\theta$ | $\hat{x}=\hat{R}\sin\theta\cos\phi+\hat{\theta}\cos\theta\cos\phi-\hat{\phi}\sin\phi$<br>$\hat{y}=\hat{R}\sin\theta\sin\phi+\hat{\theta}\cos\theta\sin\phi+\hat{\phi}\cos\phi$<br>$\hat{z}=\hat{R}\cos\theta-\hat{\theta}\sin\theta$ | $A_x=A_R\sin\theta\cos\phi+A_\theta\cos\theta\cos\phi-A_\phi\sin\phi$<br>$A_y=A_R\sin\theta\sin\phi+A_\theta\cos\theta\sin\phi+A_\phi\cos\phi$<br>$A_z=A_R\cos\theta-A_\theta\sin\theta$ |
| Cylindrical to Spherical | $R=\sqrt{r^2+z^2}$<br>$\theta=\tan^{-1}(r/z)$<br>$\phi=\phi$ | $\hat{R}=\hat{r}\sin\theta+\hat{z}\cos\theta$<br>$\hat{\theta}=\hat{r}\cos\theta-\hat{z}\sin\theta$<br>$\hat{\phi}=\hat{\phi}$ | $A_R=A_r\sin\theta+A_z\cos\theta$<br>$A_\theta=A_r\cos\theta-A_z\sin\theta$<br>$A_\phi=A_\phi$ |
| Spherical to Cylindrical | $r=R\sin\theta$<br>$\phi=\phi$<br>$z=R\cos\theta$ | $\hat{r}=\hat{R}\sin\theta+\hat{\theta}\cos\theta$<br>$\hat{\phi}=\hat{\phi}$<br>$\hat{z}=\hat{R}\cos\theta-\hat{\theta}\sin\theta$ | $A_r=A_R\sin\theta+A_\theta\cos\theta$<br>$A_\phi=A_\phi$<br>$A_z=A_R\cos\theta-A_\theta\sin\theta$ |

Permittivity of free space, $\varepsilon_o=8.854\times10^{-12}\,F/m$

Permeability of free space, $\mu_o=4\pi\times10^{-7}\,T.m/A$